

Independent Long-range Nuclear Signal Transmission Processing System

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Abstract—With the development of unclear information transfer technology, modern nuclear analytical techniques has higher demand on nuclear information transmission and processing, especially for some 24 hours monitoring sites, which need for real-time monitoring and processing of data, the system integrates the Server and the Client into one service platform, may exchange functions of each part if necessary. The system sets a specific port to transfer and process nuclear data, and make sure the Client (nuclear detection instruments) is real-time controlled by the Server. The system is widely used in various types of unmanned long-range nuclear data processing and multi-level information transmission.

Keywords—long-range nuclear information transmission, real-time control, function exchange, multi-level information transmission;

I. INTRODUCTION

due to increased demand for real-time transmission of nuclear information and multi-level information transmission, the modern nuclear information transfer technology has phased out the use of U disk or removable hard disk storage devices .etc as a data transfer method, and real-time transmission method by the present is mostly using the GPRS module, Bluetooth with routers, video camera surveillance and other ways to achieve, some others use optical fiber networks with some of the information transmission server as a transit, but most of them can only make one-way operation[1][2][5]. By using common two-way communication tools will greatly increase the risk of information leakage. Nuclear workers always value their own research data, but now lots of valuable research data is peeped illegally with the network developing[3][4][5].

The system uses the local computer as the Server, run the matched Client in the supported area to achieve real-time transmission and processing. The Server and the Client can also exchange functions. The system uses the independent IP dress and the user-defined port to maximize the protection of data privacy, achieve two-way transmission and processing. The system is stable, safe and easy to understand and operate.

II. PRINCIPLE

System is divided into two major parts — the Server and the Client. The Server can set the parameters of data transmission, get nuclear information passed by the Client to save, analysis processing, etc. It also can manage the Client, such as disabling or restart or shut down the Client computer, print data, etc. The function of the Client is to gather data from nuclear equipments, to enable real-time data acquisition and transmission, to compatible with various types of data collection instruments.

Because of web-need, the system can not only for LAN transmission, but also supports anyone with the corresponding side of the external network to transfer data. But the Server needs monopolize IP dress, if not, the Sever needs to port mapping or DMZ host. The Server sets up service login IP dress and the port number (1 ~ 32767) which may be changed at any time to manage the Client. The Client is a one-time use; function of transfer will be canceled after using, in order to completely cut off the possibility of data replication.

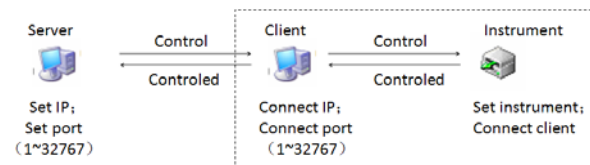


Fig.1 Elementary Diagram

Measuring instruments connected with the Client, controlled by the Client operating system, which can read real-time data and make up with the current system time as combinations, and then the Client sends data array to the Server, the transmission speed can be set by the Client or the Server and the Server is priority.

For simplicity and consistency of operation, the system combines the Server and the Client in a single interface, allows the Server change unidirectional into the Client in order to turn out the ownership, get information gathering feedback and make multi-level transmission.

III. METHODS

E-language is a kind of object-oriented, cross-platform, general-purpose computer programming language. It is fully object-oriented programming language which is similar with Java, C # and other programming languages. The syntax is

born out from the "Class C", which have similar or even common with C, C++, Java, C# and other programming languages [6].

System uses E-language because its integration of an independent source of server and client, so the system can make use of this platform to create a separate remote control system and add instructions to the Server and the Client, form an intuitive interface.

System operate the way mainly with the mouse-click the button mode, very few commands in text trigger, greatly facilitate the understanding and operation of nuclear workers, and effectively improve the work efficiency.

A. Process Flow Chart

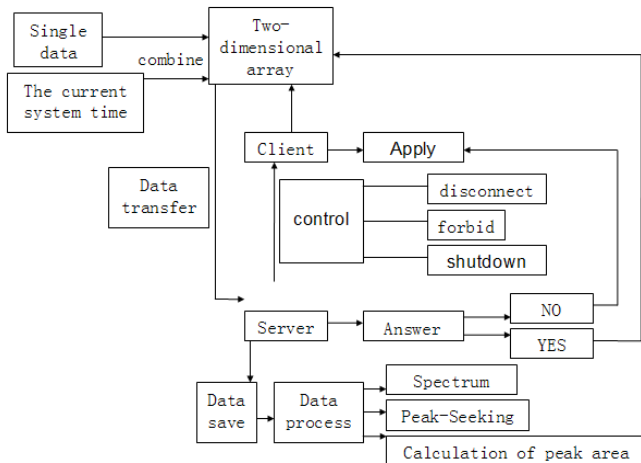


Fig.2 Flow Chart

Due to higher requirements on transmission and control of confidentiality, the system set the command of the server priority in any case, to avoid problem such as superposition or many-fold command, and the server uses feedback control, to avoid blind-time while uses clock to control, so it achieve a true real-time control. For clients, the first is to combine data which gathered by the instrument, directly generate two-dimensional array, avoid the waste of server resources, reduce the server workload.

The server will automatically shut down the port when data transfer is finished, in order to protect data privacy and prevent the use of client again. If necessary, Sever can re-open port to connect manually, and can also specify the time, the IP, the designated port to connect for easy unmanned operation.

B. Algorithm

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Smooth spectrum: the system uses arithmetic moving average method to smooth spectrum, the formula is as follows:

$$\overline{data}_i = \frac{1}{2m+1} \sum_{j=-m}^m data_{i+j}$$

If the no.i point is to be smooth, get m points of its both side and the total points is 2m+1. Calculate the mean arithmetical value is set as the no.i point's corrected value.

This method does not smooth the edges of the m points on both sides; this phenomenon is called the edge losing.

Peak-seeking: the system uses symmetric zero-area transform to find the peak, area of zero "window" function with the experimental spectrum data convolution transform, and request "window" function for the symmetric function. Convolution of linear substrate conversion will be zero, peaks only exist where there is non-zero. Therefore, the symmetry of the original spectral data reflects the spectrum of zero-area transformation peak shape changes.

The formula is as follows:

$$\tilde{y}_i = \sum_{j=-m}^m C_j data_{i+j} \quad \sum_{j=-m}^m C_j = 0 \quad C_j = C_{-j}$$

y_i is the transformed spectrum data, $data_i$ is the original experimental spectra data, C_j is zero-area symmetric transformation function, $W = 2m + 1$ is the window width.

Peak shape function is characterized by a difference between a specific function and a constant "d".

$$C_j = G_j - d \quad d = \frac{1}{W} \sum_{j=-m}^m G_j$$

$$G_j = \frac{H^2}{H^2 + 4 \times J^2}$$

Find peak criteria:

In order to make the sensitivity of find the peak has nothing to do with the statistical experimental spectra, the transform spectrum of standard deviation is as a way to find the peak, that is, when transform spectrum and the ratio of its standard deviation there is extreme, and this extreme is higher than a given value f, it considered the peak.

$$SS_i = \frac{\tilde{y}_i}{\Delta \tilde{y}_i} = \frac{\sum_{j=-m}^m C_j data_{i+j}}{\left(\sum_{j=-m}^m C_j^2 data_{i+j} \right)^{\frac{1}{2}}} > f$$

Determine the peak: the channel corresponds with extreme value.

"f" is a constant, a sensitivity factor.

Determine the border of the peak: on the both sides of the negative peak site of SS_i positive peak.

Half-width: 2 zero intercept [7][8][9][10].

Calculation of peak area: peak area calculated using a linear background method, the boundary points around the peak is straight line; connect the line as a background line, calculated by trapezoidal method.

$$B = (data_L + data_R) \times \frac{(R - L + 1)}{2} = (y_L + y_R) \times \frac{(R - L + 1)}{2}$$

$$S = \sum_{i=L}^R data_i$$

$$A = S - B$$

IV. RESULTS AND DISCUSSION

A. Basic Setting

The software testing service built on the router, the router model is: Qwest Modem Configuration 2Wire 2700HG-D, the machine model is: china-983baaeca, set the machine as DMZ host, add the application to enable the port mapping, so it can make the exchange of information on the network, or LAN can only operation.

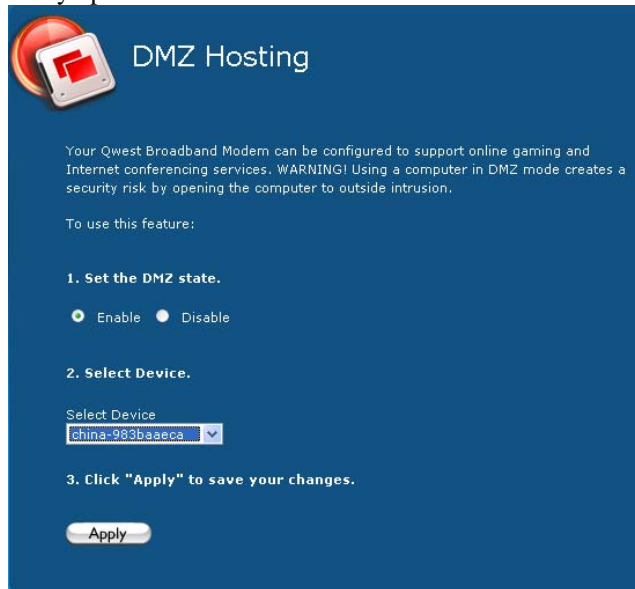


Fig. 3 DMZ Hosting

The Client is allowed to connect to the specified IP address (119.4.132.227) and randomly assigned to an open port (51718). Test computer uses USB to connect to X fluorescence spectrometer in order to transfer the data to Host computer. The Host computer processes data and save the results. This transmission interval is 500 milliseconds.

B. Software and Results

The system function interface includes 5 main menus: File, Data Processing, Tool, Long-Range Control and Help. File menu is divided into Open, Save, Print; Exit these 4 sub-menus, to achieve the matched function, each function is provided dialog box, allows the operator to decide.

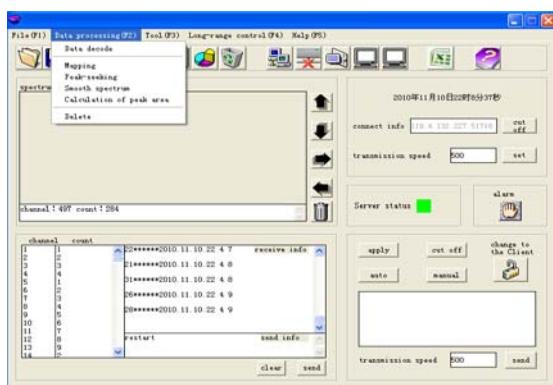


Fig.4 the Integration Software Interface of the Sever and the Client

Data Processing is divided into 6 sub-menus: Data Decoding, Mapping, Peak Searching, Spectral Smoothing, and Peak Area Calculation, Remove. The main function of Data Decoding is to decode the encrypted data which has been received to make the data normal. Mapping is to strip the spectral data and time data, describe the point information with the channel. Peak Search, Spectral Smoothing, Peak Area Calculation, Remove are functions of the spectral data processing.

Tool menu includes spectrum of zoom, left and right shift.

Long-Range Control menu is divided into Connect, Disconnect, Disable the Client, Restart the Client, Close the Client the five sub-menus to achieve function respectively.

Help menu of the system that a detailed description of use of the window.

Below the main menu is a row of shortcut keys corresponding to the main menu that can easily call the menu function.

The main interface is divided into four regions; the upper left area is the spectral data processing interface for the display of spectrum, spectrum processing, and mouse capture spectrum of information display. Spectrum of the lower left area is the text information display, the spectrum of the channel values and the corresponding peak; to accept real-time client information display and text commands of the trigger box interface. The top right area is the current system time zone, the display of the Server connection information, the setting of transmission speed. If the data is illegal peeped, the Server will automatically alarm, directly save the existing data and close the Client computer and the Server status in the bottom turns red. Function of the lower right area is the Client functional areas, press the convert button to lock the function of the Client, then all the features of the Server cannot be used, the main functions of the Client is apply for connecting the Server, Disconnect the Server, automatically real-time transmission of data collection, manual type to send messages, set the transmission speed and other functions.

V. CONCLUSIONS

E-language based on long-range nuclear signal acquisition and processing system uses point to point mode server hosted, real-time remote nuclear signal collection, secure transmission, processing and display. System can also be used in simple data analysis, only data on the existing spectrum corresponding data processing, such as smooth, peak search, peak area calculation, content computing. Not only support the LAN data transmission, also supports the external network communication, with a wide range of applications

and high stability. Advantage of the master server is simple, confidentiality, anti-interference ability, etc., can also automate the management, the system telemetry signals in the nuclear, non-contact measurement, time domain measurement occasions given extensive application.

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